

Wheelchair mobility performance of elite wheelchair tennis players during four field tests: Inter-trial reliability and construct validity

**Thomas Rietveld, Riemer J. K. Vegter, Rienk M. A. van der Slikke,
Aldo E. Hoekstra, Lucas H. V. van der Woude, Sonja de Groot**



Wheelchair tennis

- › Increasing popularity₁
- › Wheelchair mobility performance₂
- › Tennis racket



¹ Gold, J. R., & Gold, M. M., 2007

² De Witte et al., 2018



Previous Research

- › Wheelchair basketball_{2,3} & rugby₄
- › Research scarce
- › IMUs_{5,6} → More detailed performance
- › Four field tests developed

²De Witte et al., 2018

³De Groot et al., 2012

⁴Gee et al., 2018

⁵Van der Slikke et al., 2015

⁶Van der Slikke et al., 2016

Aims

1. Inter-trial reliability and construct validity of four field tests
2. Assess added value of each test

Participants and design

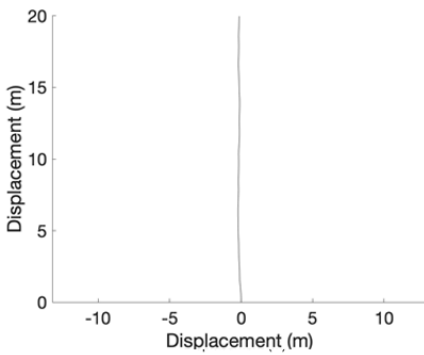
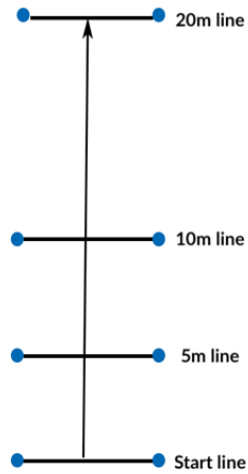
- › 21 participants (12 juniors, 9 adults)
- › 4 skill oriented tests (2 trials each)
- › 3 IMUs
- › Own wheelchair and racket

Placement IMUs

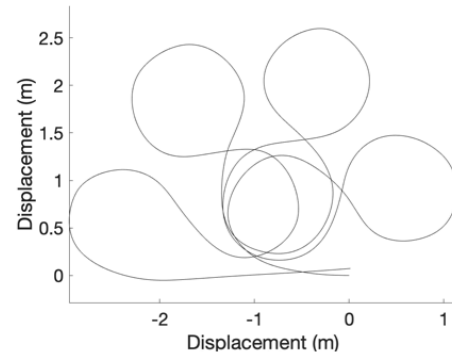
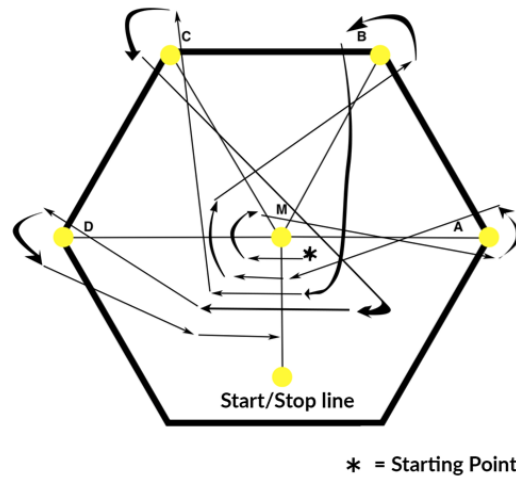




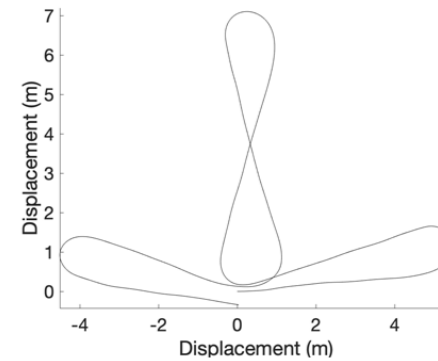
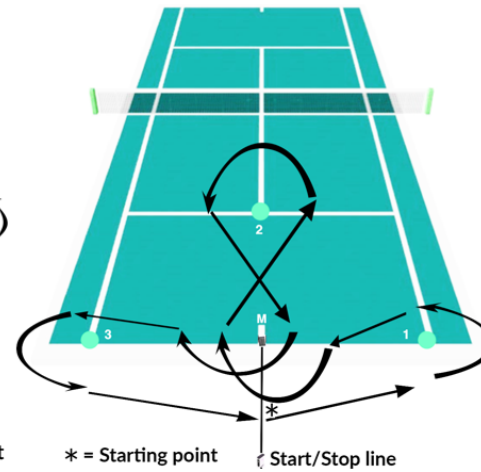
20m Sprint test



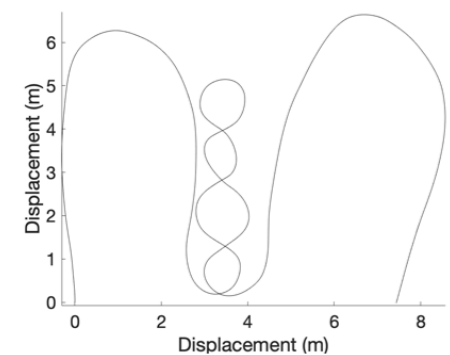
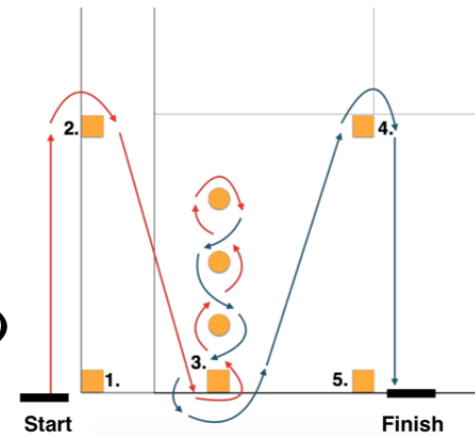
Spider test



Butterfly-Sprint test



Illinois test



Data Analysis

- › Trial times based on IMU data
 - 20m Sprint, 20m point
 - Other tests, based on figures
- › Wheelchair mobility performance variables

| Variables | Description |
|---|--|
| Velocity | V_{mean} Mean velocity on whole test [m.s^{-1}] $V_{\text{peak } 5/10/20\text{m}}$: Peak velocity first 2/5/10 meters [m.s^{-1}] $\text{Pos}_{V_{\text{peak}}}$: Position of the peak velocity [m] V_{peak} : Peak velocity on whole test [m.s^{-1}] |
| Acceleration | $a_{\text{peak } 5/10/20\text{ m}}$: Peak forward acceleration first 2/5/10 meters [m.s^{-2}] $\text{Pos}_{a_{\text{peak}}}$: Position of peak forward acceleration [m] a_{peak} : Peak forward acceleration on whole test [m.s^{-2}] |
| Push characteristics | N_p : Number of pushes $D_{p1,2,3}$: Displacement after first, second, third push [m] CT_{mean} : Mean Cycle Time [s] |
| Rotational velocity/acceleration | $\text{Rot}V_{\text{mean right/left}}$ Mean rotational velocity during right/left turn $\text{Rot}V_{\text{peak right/left}}$: Peak rotational velocity during right/left turn $\text{Rota}_{\text{peak}}$: Peak rotational acceleration |



Statistical Analysis

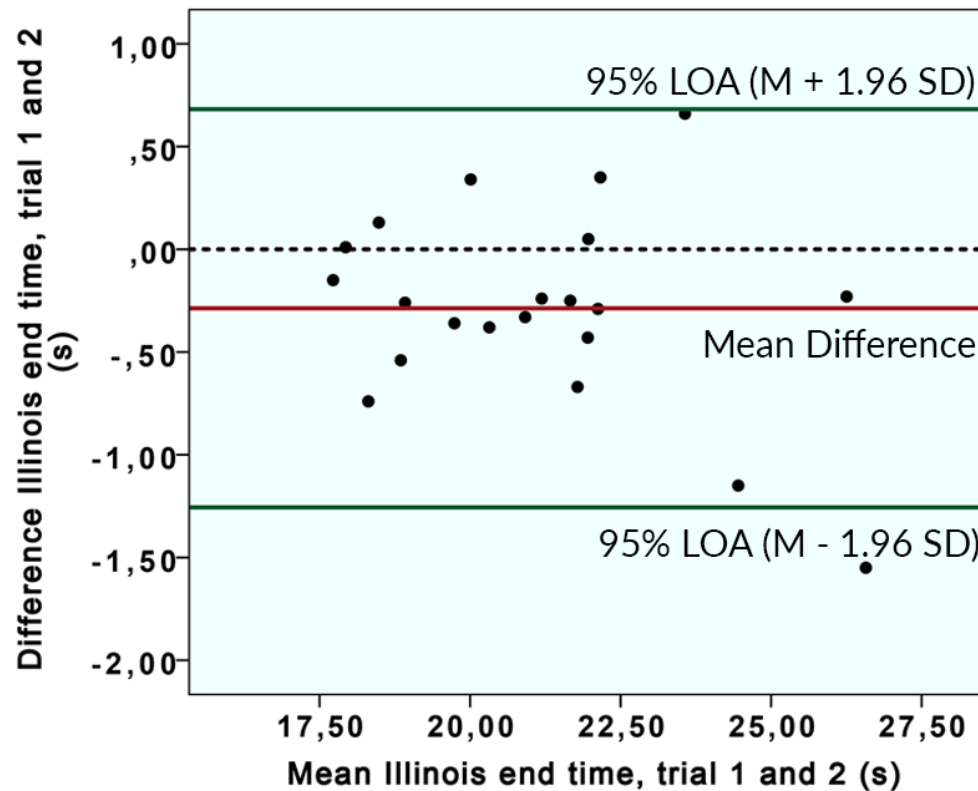
- › Inter-trial reliability
 - Absolute reliability (Paired t-tests)
 - Relative reliability (ICC)
- › Construct validity
 - Three Repeated measures ANOVA
 - MANOVA

Statistical Analysis (2)

- › Association among end times
 - Pearson correlations



Results Reliability



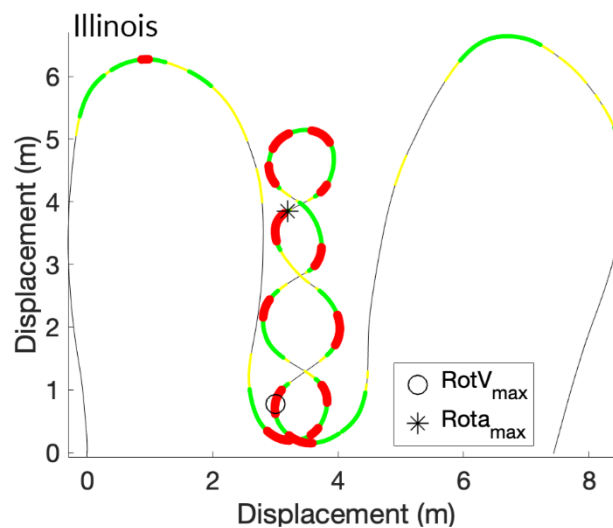
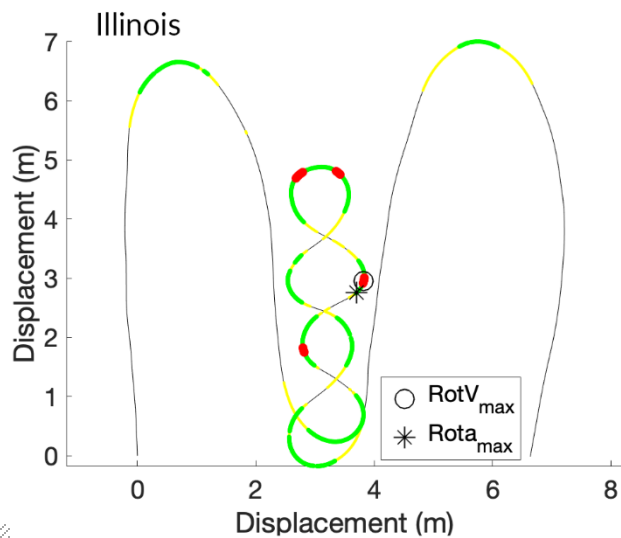
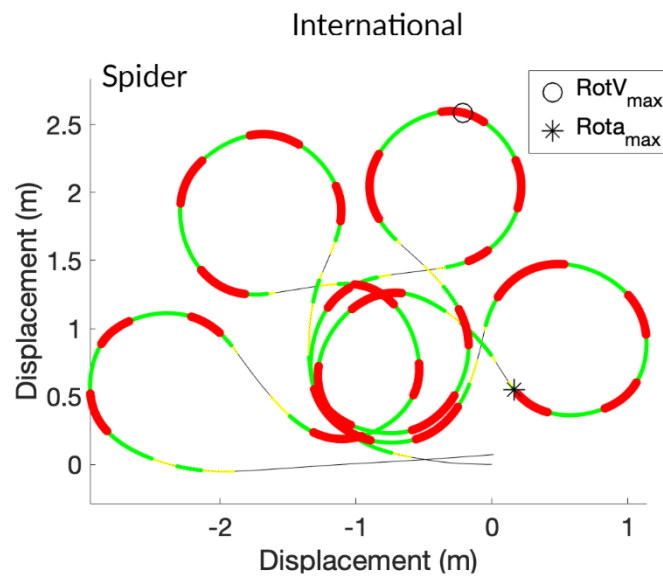
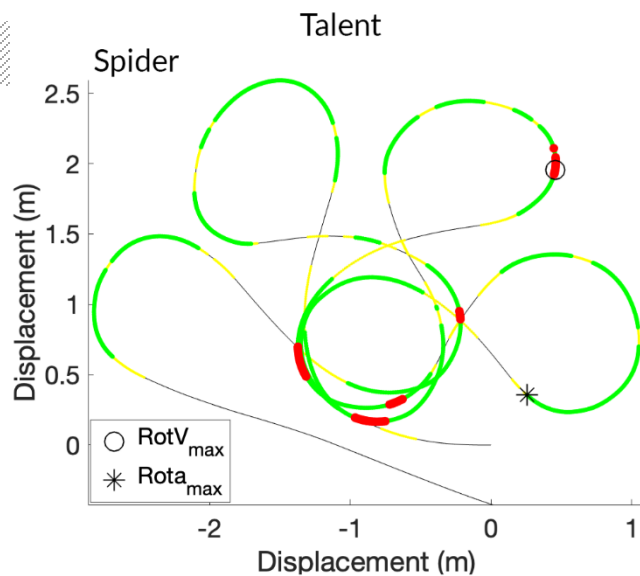
Results validity and association

- › Adults were faster on all 3 tests
- › Wheelchair mobility performance
 - Velocity
 - Acceleration
 - Rotations
 - Not the Position
- › Strong association



Discussion

- › Inter-trial reliability ✓
 - Illinois at least two times
- › Construct validity ✓
 - Discrimination can be made
- › Association among tests
 - 20m Sprint and Spider test





Future Recommendation

- › Coast down test
- › Power Output
- › Interaction with the ball
- › Key factors during match

Conclusion

- › Field tests are reliable and valid to measure wheelchair mobility performance
- › With the use of IMUs it is possible to visualize and give important information

Thank you for your attention

